Historic, Archive Document

Do not assume content reflects current
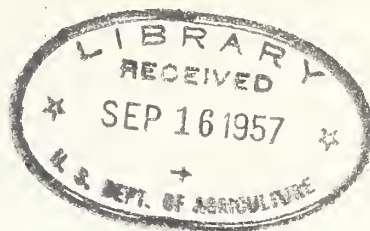scientific knowledge, policies, or practices.

PONDEROSA PINE TREE GRADES
AND
USE FOR APPRAISAL OF TIMBER QUALITY

By

I. V. Anderson [1]

March 1955

BASIS OF THE RULES

These rules are based on observation of growth and lumber yield of
ponderosa pine through the different life stages of the tree.

During the various stages of growth a ponderosa pine tree develops
natural characteristics that affect lumber grades. These characteristics
can be used to measure the quality and value of lumber produced by each
tree. In the shorter trees of any species of Region 1 the characteristics
of the butt (16 foot) log determine quality of the tree, and in longer
trees the first two 16-foot logs dominate. Hence much time and effort
are saved with no significant inaccuracy by using the tree as a unit. In
ponderosa pine it is usually the first 16-foot log that determines the
grade.

TREE CHARACTERISTICS AND GRADES

Age of the tree is a primary consideration and position in the stand a
secondary one in the development of these tree grades.

Knot characteristics and their relative position or scarcity are probably
the most important considerations in determining lumber quality. Sound
knots, or live knots, come from live branches while encased or loose knots
come from dead branches. Hence the age of a tree and its position in a
stand have a great deal to do with the amount of green knotted material
produced. Therefore young bull pine trees are usually sound knotted. This
is the grade of tree that has been designated as Grade 3. As the young
bull pine advances into the teen-age or older bull pine stage some of the
lower limbs die because of lack of light and the trunk continues to grow
around them. Hence we get black or loose knotted lumber of lower grade
from the butt logs of these trees. These trees have been designated Grade
4. As the tree reaches maturity the dead limbs drop off and clear wood
is grown on the trunk. When the natural pruning process has been complete
for many years we get select lumber producing trees, or Grade 1. Likewise,
trees that do not prune themselves up quite completely and have a widely
spaced knot arrangement make Grade 2 trees, or shop lumber producing trees
when they get into maturity or overmaturity.

---

[1] Chief, Forest Utilization Service. Additional copies may be obtained
from Director, Intermountain Forest and Range Experiment Station,
Forest Service, U.S. Department of Agriculture, Ogden, Utah.

Among the mature and overmature trees we have a third tree type which, unlike the select trees, is rather limby, and which, unlike the shop trees, has its dead limb stubs more closely spaced. This is the Grade 5 tree and it produces a mixture of lumber grades. It is the most common tree in mature and overmature stands and from the standpoint of evaluating ponderosa pine timber can be regarded as the average or par tree. Most significant from the standpoint of the method described here is the fact that the average selling value of lumber obtained from a mill study of Grade 5 trees was approximately the same as the regional current mill run price of ponderosa pine lumber.

A fourth category of mature and overmature trees is the defective and wolf type trees which are grouped in Grade 6. This category also contains the crippled trees, probably damaged in earlier years by porcupines, or otherwise decadent and trees that are unquestionable culls on a falling lumber market. Much of the lumber from these trees is in the 4 and 5 common grade.

Tree grades are pictorially presented in Figure 1. Several hundred trees were graded to determine the form depicted in this figure as well as the characteristics of age and size and other characteristics shown in Figure 2.

USE OF THE AVERAGE OR GRADE 5 TREE

Determination of tree quality is not a matter of precise mathematical solution since very few things in the biological field lend themselves to precise calculations. So we must combine the judgment factor with the mathematical solution. We do that when we call the Grade 5 tree the average of the locality and assign a regional selling value to it. As more experience is gained and additional lumber yield data obtained it will no doubt be possible to further localize tree quality differences by use of a different average selling value in the several localities of the region. For valuation purposes the lumber from Grade 5 trees is considered as 100 percent in relation to the value of lumber from other tree grades.

The following tabulation shows the relative value of each of the six tree grades in relation to the Grade 5, or average tree. For example, a Grade 1 tree produces lumber which on the average is 35 percent more valuable per thousand board feet than lumber from Grade 5 trees.

Grade	Relative value per thousand board feet
1	135
2	115
3	95
4	80
5	100
6	70

There may be changes in the utilization of a species that will alter the foregoing percentage relationships. For instance, a market for sliced knotty ponderosa pine flitches might develop. These would come from the first two logs of Grade 3 trees and some of the tops of Grade 4 trees. Adjustment of the percentage relationship for these two tree grades could be made accordingly.

As experience in tree grading and making of lumber yield studies in the sawmill are acquired, it may be desirable to set up a separate grade recovery index for
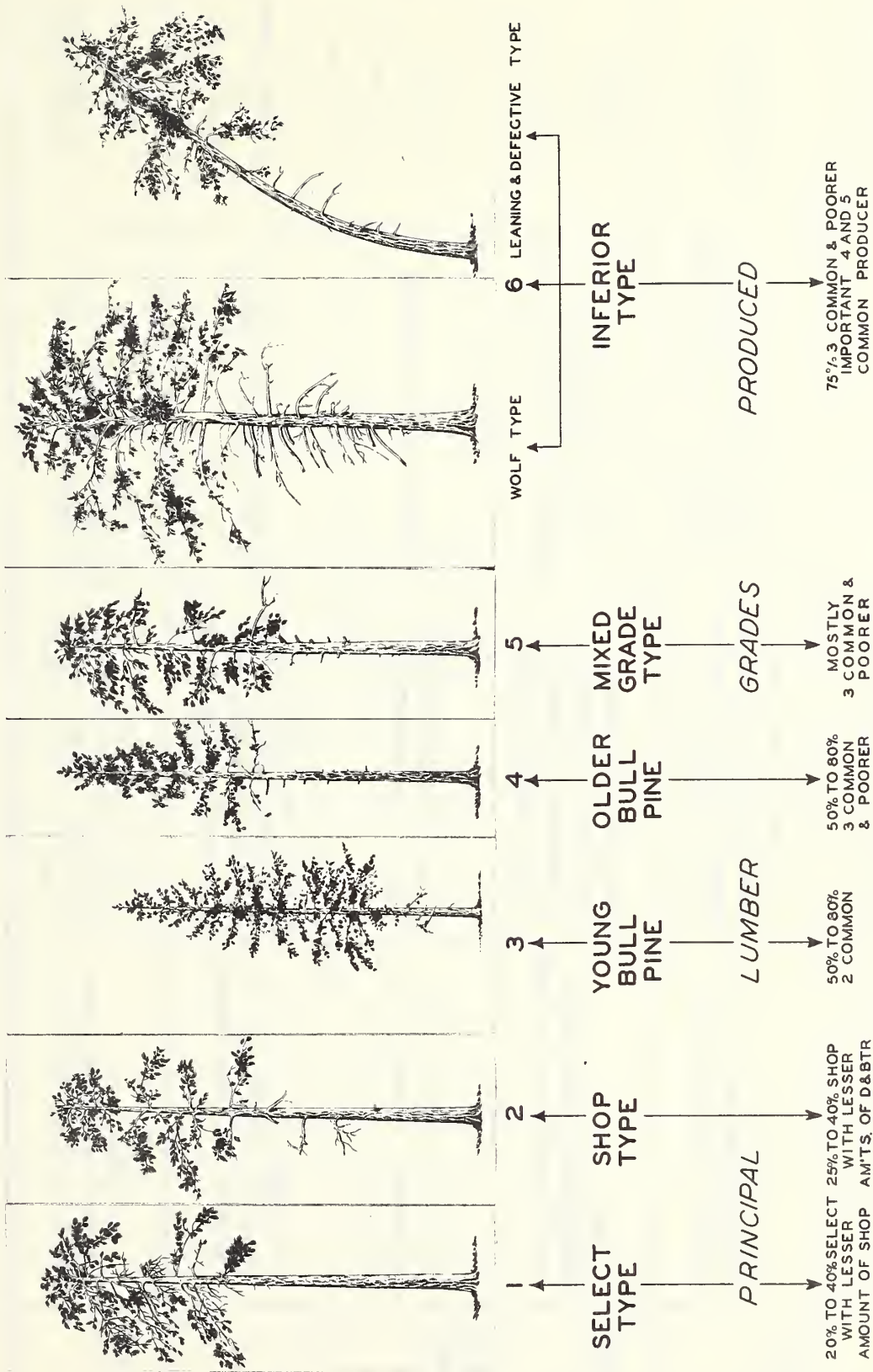
ECONOMIC TREE GRADES FOR PONDEROSA PINE

1	2	3	4	5	6	
SELECT TYPE	SHOP TYPE	YOUNG BULL PINE	OLDER BULL PINE	MIXED GRADE TYPE	WOLF TYPE	LEANING & DEFECTIVE TYPE
					INFERIOR TYPE	
PRINCIPAL		LUMBER		GRADES	PRODUCED	
20% TO 40% SELECT WITH LESSER AMOUNT OF SHOP	25% TO 40% SHOP WITH LESSER AM'TS. OF D & BTR	50% TO 80% 2 COMMON	50% TO 80% 3 COMMON & POORER	MOSTLY 3 COMMON & POORER	75% 3 COMMON & POORER IMPORTANT 4 AND 5 COMMON PRODUCER	

FIG. 2 — TREE GRADES FOR PONDEROSA PINE

GRADE NO.	AGE	LUMBER PRODUCTION	SIZE LIMITS	KEEN CLASS
1 (SELECT)	mature or overmature usually 300 years or older.	ordinarily 20 to 40% D&BTR. select with lesser amounts of shop lumber.	seldom under 20"d.b.h. except on poorest sites.	Invariably 3 and 4 rarely 1 or 2
2 (SHOP)	mature or overmature usually 300 years or older.	ordinarily 25 to 40% of shop lumber all grades–with lesser am'ts of D&BTR.	rarely under26"d.b.h.	usually 4 sometimes 3
3 (BULL PINE YOUNG)	immature–usually not over 120 years old.	yield 50 to 80% of #2 common lumber	seldom over 18"d.b.h.	usually 1 rarely 2
4 (BULL PINE OLD)	just going into maturity usually not over 250 years.	yield 50 to 80% 3 common & poorer including 3 shop and inch shop.	rarely under 18"d.b.h. and seldom over 30"d.b.h.	usually 2 rarely 1 and 2
5. (MIXED GRADE)	usually mature and overmature and over 250 years.	yields mixture of grades–3common& poorer predominate–1&2 common comparatively rare.	seldom under 20" d.b.h. except on poorest sites	usually 3 and 4
6 (INFERIOR)	usually mature or overmature but may be any age.	invariaby 75% 3 common and poorer–frequently all 4&5 common.	any size	usually 3 and 4 but may be any class

each tree grade. Current lumber prices could then be applied to these grade indexes. However, until such information is considered desirable and practicable, the foregoing "average tree" method of appraising quality is recommended.

In the use of average selling values adjustments because of diversion from the sawmill of certain lumber grades and veneer logs is frequently necessary.

APPLICATION OF TREE GRADES

Data by tree grades can be taken at the time of a volume cruise but it is preferable to make a valuation survey at the time logging and other appraisal data are taken. Furthermore, after examination of the characteristics of the volume data, one is in a better position to determine a sound and adequate quality sample. Usually timber quality is recorded on 1/5-acre plots with a plot interval of 5 to 10 chains. Plot interval depends, of course, on the size of the area. On a regular shaped timber area of small volume, possibly a random line through the area would be better.

A sample case of application of the tree grades and determination of average selling value of the lumber sawn from the timber is herewith presented. The timber on Big Pine Creek contained a separate area of young growth hence it was given separate consideration for the quality appraisal. Table 1 presents data on old growth which constituted about 95 percent of the stand.

Table 1. Summary of quality of old-growth timber
Big Pine Creek Sale Area

Cruise based on 44 plots = 8.8 acres. Included 120 trees or 647 logs

Tree Grade	Net volume on 8.8 acres in cruise	Volume per acre net	Percent volume in each tree grade
1	78,940	8,970	41.8
2	3,800	430	2.0
3	---	---	---
4	820	90	.4
5	93,920	10,660	49.7
6	11,510	1,310	6.1
Grand Total		21,460	100.0

Average tree - 1575 ft. net = 5.4 16-foot logs per tree
Average log - 292 ft. net = 3.4 16-foot logs per M

-5-

Table 2. Summary of quality of young timber
Big Pine Creek Sale Area

Tree Grade	Volume per acre adjusted for 5 percent defect	Percent of volume in each tree grade
1	700	6.1
2	0	.0
3	50	.4
4	8,670	75.9
5	1,390	12.2
6	610	5.4
Total	11,420	100.0

Basis 26 plots

Table 1 shows that 41.8 percent of the volume in this stand is in No. 1 trees. This is somewhat better than the average for ponderosa pine timber. However, there was only 2 percent of No. 2 or shop grade trees. Usually if there is a large volume of No. 1 tree grade there is a dearth of shop trees. There is no young bull pine or Grade 3 trees in the stand and only .4 percent of Grade 4 trees or older bull pines, 49.7 percent of Grade 5 trees, and 6.1 percent of Grade 6.

Similar data are shown in Table 2 for the young timber area of Big Pine Creek.

The next step in the application of tree grades is shown in Tables 3 and 4. The average selling price of ponderosa pine F.O.B. mill (all grades combined) can be determined from local sources or the Regional Forest Service index. Since the average selling value of lumber from Grade 5 trees is practically the same as the current average wholesale F.O.B. mill selling value of all ponderosa pine cut in the locality or region, the Grade 5 tree might be assigned the selling value of $80 per M[1]/ The value per M board feet of the other tree grades are determined by multiplying $80 by the percentage factors presented in column 1 of Tables 3 and 4.

These values are then weighted by the percentage of volume of each tree grade. For instance, Table 3 shows 41.8 percent of the old-growth volume in Big Pine

1/ Merely for example and not representative of selling value of today.

Creek to be in Grade 1 trees. Hence 41.8 percent times $108 equals $45.14, the weighted selling value per M feet, lumber tally of lumber produced from Grade 1 trees. Carrying out this same calculation for all tree grades an average selling value per M, lumber tally, of $90.42 is obtained for the old-growth timber, and $68.25 for lumber produced from the young-growth timber. This is quite a spread. Weighting these values by the percentage of old-growth and young growth contained in the Big Pine timber chance we obtained an average selling value per M feet of lumber produced from the entire stand. The calculation is as follows:

Percent old growth: .945 x $90.42 = $85.45
Percent young growth: .055 x 68.25 = 3.75
Weighted average selling value per M of lumber
produced from the Big Pine chance = $89.20 or
$9.20 over the current average price of ponderosa
pine lumber.

This selling value must then be worked back to the stumpage value by the customary appraisal methods. Any company using this system would naturally use its own production cost profit margin and overrun figures in its calculations.

Table 3. Computation of the selling value of lumber produced from old-growth timber on the Big Pine Creek Sale Area.

Tree Grade	Standard ratio to average selling value	Selling value of lumber based on current average value of $80 per M	Volume by tree grades to be cut from plot	Weighted selling value
	(1) %	(2) $	(3) %	(4) $
1	135	108.00	41.8	45.14
2	115	92.00	2.0	1.84
3	95	76.00	---	---
4	80	64.00	.4	.26
5	100	80.00[1]/	49.7	39.76
6	70	56.00	6.1	3.42
All			100.0	90.42

1/ Par value

Table 4. Computation of the selling value of lumber purchased from young timber on the Big Pine Creek sale area.

Tree Grade	Standard ratio to average selling value	Selling value of lumber based on current average value of $80 per M	Volume by tree grades to be cut from plot	Weighted selling value
	(1) %	(2) $	(3) %	(4) $
1	135	108.00	6.1	6.59
2	115	92.00	0	0
3	95	76.00	.4	.30
4	80	64.00	75.9	48.58
5	100	80.00[1/]	12.2	9.76
6	70	56.00	5.4	3.02
All			100.0	68.25

[1/] Par value

SOME ADVANTAGES AND DISADVANTAGES OF TREE GRADES

Naturally there are some disadvantages to the system. Also, there are some relative inaccuracies, but it appears that these are largely compensating. There is nothing in the biological world that lends itself to exact mathematical calculation and solution and the ponderosa pine forest is no exception. The greater we strive for accuracy the more involved our calculations could become until the system would fall down of its own weight and the appraiser could not see the woods for the trees.

Regarding inaccuracies, we know for instance that overrun varies with log and tree size. To apply a different correction factor for overrun to each tree grade would be a rather needless complication unless one were dealing with an unusually abnormal dispersion of tree size and form such as is rarely encountered. On the advantage side, the system is simple and can be mastered by anyone with a reasonable knowledge of ponderosa pine timber and the lumber produced therefrom and simple arithmetic. Even simple arithmetic is complicated. Many a college graduate is floored with a seventh grader's problem. Hence the foregoing application of tree grades to determine average selling value per M of lumber may seem a bit complicated, but it is comparatively simple to other methods that have been proposed.

SUMMARY

There are five steps in the method of determining selling value of lumber produced from ponderosa pine timber. They are as follows:

1. First determine the size and character of the sample by examination of the cruise data.

2. Determine percent of volume of different tree grades in each timber unit.

3. From local sources or regional price index determine the current average ponderosa pine lumber selling value per M board feet. This, then, is the par value of lumber from a Grade 5 tree and is 100 percent of the selling value of lumber produced from the timber chance.

4. Apply standard percentage ratios to lumber selling value per M through all tree grades.

5. Apply percentages of each tree grade to selling values obtained from step 4. Summarize weight of selling value of each tree grade and you have the average selling value of lumber produced from the stand you have cruised.